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ANAEROBICALY - COMPOSTED ENVIRONMENTAL WASTES AS ORGANIC FERTILIZER AND IDENTIFICATION OF THE ASSOCIATED FUNGAL COLONY.

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Abstract
The increasing generation and unhealthy disposal of organic waste in Nigeria necessitate this experiment. The anaerobic composting process of sawdust, wood shavings and poultry manure was conducted at Ambrose Alli University, Ekpoma, and their associated fungi were identified and isolated. The fungi identification was achieved by observing the morphological characteristics of the individual compost materials alongside the use of electric photo microscope. The isolation of fungi colony was carried out by serially diluting a sample of each compost material that were cultured in a Potato Dextrose Agar (PDA). From the analysis, the compost sample was high in organic carbon, nitrogen, phosphorus, calcium, magnesium, potassium and other mineral elements. The nine pure potential cellulose degrading fungi identified were; *Aspergillus candidus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Fusarium species*, *Penicillium aethiopicum*, *Penicillium funculosum*were, *Penicillium oxalicum*, *Penicillium polonicum, and Penicillium variable*. In conclusion, the above named fungi were responsible for the decomposition of lignified materials such as sawdust and wood shavings. In conclusion, the above named fungi were responsible for the decomposition of lignified materials such as sawdust and wood shavings. It is important to note that these compost were found to be rich in organic matter and mineral nutrients which make them ideal supplement to inorganic fertilizer, and could be useful for sustainable crop production.

Keywords: Anaerobic compost, fungi, isolation, identification, nutrient content.

1.0 INTRODUCTION

The increase generation and disposal of waste in Nigeria is of great concern because of the increasing rate of environmental pollution. It is therefore important to identify possible ways to utilize the waste materials. Composting is one of the low cost alternatives for minimizing the volume of these waste disposed materials with a potential for economic gain from resources recovery by converting putrescible organic matter into plant nutrients (Ashraf *et al.*, 2007). According to Edward *et al.* (2007) good quality compost had a significant impact in improving soil quality and crop yield.

Composting is a fertilizing mixture of partially decomposed organic matter from plants and animals origin. The active component mediating the biodegradation and conversion processes during compositing is the resident microbial community among which are fungi, bacteria and actinomycetes. Therefore, optimization of compost quality is directly linked to the composting process (Makeshkumar and Maholingan, 2011; Peter *et al.*, 2006).

Fungi mostly *Aspergillus* and *fusarium* are detrimental to all living things, causing field and post-harvest lost. Fungi play a very important role in composting because they used carbon sources mainly lignocellulosic polymers that catalysed composting process to maturity stage. Compost relies on micro-organisms for stability and maturity. Fungi also degrade complex materials such as polyaromatic compound (Ashraf *et al.*, 2007).

Adequate moisture and temperature are important factor for microorganisms that enhance the breakdown organic matter. Effective microorganism and cellulose decomposing fungi also maintain

elevated temperature in the composting process. Anaerobic composting describes the process of putrefactive breakdown of organic matter by reduction in the absence of oxygen where end products such as methane (CH_4) and Hydrogen Sulphide (H_2S) are released. According to Martin (2007) anaerobic destruction of organic matter is a reduction process and the final product, humus, is subjected to some aerobic oxidation.

The final product of composting is known as compost and it is used as soil conditioner which returns nutrient and organic matter to soil thus closing the organic loop. Composted organic materials such as plants and animals debris add nutrient to the soil thereby increasing the soil fertility. It improves plant growth and makes the plant less prone to infection by pathogens (Mohammed *et al.*, 2001). Compost can potentially replace synthetic fertilizer which is also a source of ground water pollution. Compost making is a simple means of improving soil fertility status and sustain crop production as well as reducing farmers dependence on mineral fertilizer.

It is therefore important to identify and isolate the type of fungi that are associated with composting under anaerobic condition also to reduce environmental pollution through compost making.

2.0 Materials and Methods

2.1 Experimental site

The composting was carried out at Ambrose Alli University, Emaudo Annex, Ekpoma, Edo State. Ekpoma lie on latitude $6^{\circ} 42^{1}$ north and longitude $6^{\circ} 9^{1}$ east, with average amount of rainfall 1750mm.

2.2 Materials and Methods

Poultry manure was collected from battery cage system of poultry hatchery and wood shaves/sawdust were collected from sawmill and the top soil was collected under *Luceanea lucephela* plant at Emaudo Campus, Ekpoma. The substrates were then mixed with water to raise the moisture content to 50% which is a suitable range for microorganism responsible for decomposition (Wipo, 2007). Proper turning was done weekly. The buckets were covered with the lid, thick dark cellophane bags and was tied round with twine (rope) to prevent air. As the composting progressed, the materials were regularly inspected and the compost matured at sixteenth week. The temperature was taken during composting and it was observed that there was a gradual increase in temperature.

2.2.1 Chemical analyses

The following chemical analyses were done on the compost (to determine its value as fertilizer material): The pH was determined in water (ratio1:1, soil: water) (Bouyoucos, 1962). Organic carbon was determined by wet dichoromate method (Nelson and Sommer, 1975) and Available phosphorus by Bray extraction method (Anderson and Ingram, 1993). Total nitrogen was determined by Kjeldahl method (Bremner and Mulvaney, 1982). Exchangeable cations (potassium, calcium and magnesium) were extracted by 1M ammonium acetate, potassium was then determined by flame photometer while calcium and magnesium by atomic absorption spectrophotometer (IITA, 1979). Micronutrients such as copper, zinc, iron and manganese were also determined according to the method of Lindsay and Norvell (1978).

2.2.2 Fungi isolation and identification from compost

Compost samples were bagged and taken to the laboratory for isolation and identification of fungi. Potato Dextrose Agar, and saline were sterilized at 121^0C for 15 minutes. The saline was used to carry out tenfold serial dilution of the soil samples. 1ml of dilution 10^{-3}, 10^{-4} and 10^{-5} was inoculated by pour plate method in duplicate in Petri dishes. Incubation was carried out at 37^0C for 3-5days.

The isolates were identified on the basis of conventional culture and morphological characteristics. Macroscopic identification was done by visualizing surface and reverse pigments on PDA plates while microscopic characterization involved shape, colour and structure of conidia, hyphae, condiophores and condial head using lactophenol cotton blue according to the methods of Raper and Fennell (1987). The arrangement of *Macroconidia* on the Conidiogenous cells either in singly, false head or chain are important in identification.

Electric photo microscope was also used for further identification and the slides were viewed at 10X objectives, 40X objectives and 100X objectives.

3.0 Results and Discussion

The temperature of the compost pile at the second week was 32°C and slightly increased to 33°C at the fourth week of composting. The temperature was taken during composting and it was observed that there was an increase in temperature at the first three weeks from mesophilic to thermophilic phase and thereafter the temperature began to decrease. Gautam *et al.* (2011) reported similar tread in temperature reading during composting. According to Michel *et al.* (1996) successful composting depend on influencing factors such as temperature, moisture content, aeration, pH, C/N ratio and composting mixtures. The mineral nutrient concentrations in composite samples of the final compost are as follows: Organic carbon – 48.76, Magnesium – 2.28Cmol/kg; Potassium – 9.20Cmol/kg; Nitrogen – 30.33g/kg; Phosphorus – 6.14mg/g; Sodium – 10.58Cmol/kg; Manganese – 180.39mg/g; Iron – 4,950.09mg/g; Cupper – 7.35mg/g; Zinc – 82.54mg/g and Calcium – 11.96Cmol/g and the pH was 7.66. The chemical composition of compost was highly dependent on composition of the materials used in the initial mixture, but the actual concentrations differ markedly because of the changes in the residual amount of material. The analysis of the compost showed that it was rich in mineral nutrients and organic matter (Table 1).

The pH of the compost was alkaline and similar result have been reported by Albaladejo *et al*. (2009). It therefore means that compost can be used as a source of liming to reduce soil acidity. The organic matter content of the compost was high and according to several authors, the reason for compost production is to improve the organic matter content of a degraded soil. Therefore, compost is an organic matter resource that has the ability to improve the chemical, physical, and biological characteristics of soils. According to Zwieten (2009) compost is high in essential plant nutrient especially nitrogen, phosphorous, Potassium (K) and other micronutrients; the above result was confirmed in this experiment.

A total of nine fungi genus was isolated from anaerobic compost which includes: *Aspergillus fumigates, Aspergillus niger, Aspergillus candidus, Penicillium aethiopicum, Penicilliu moxalicum, Penicillium funco*losum, *Penicillium polonicum, Penicillim variable* and *Fusarium Sp.* Majority of isolates were of the genus Penicillium.

Compost prepared from combination of two or more types of wastes enhanced not only the number fungi but also the diversity of saprophyte microorganism that play an important role in the biodegradation of such materials. The study of Nakasaki and Ohtaki (2002) reported that when microorganism is incubated in the presence of two or more substrates, the substrates will be degraded in the order of their ease of degradation. Besides, the presence of two substrates also increases the variety of microorganism. The fungal species were found to be numerous during both mesophitic and thermophilic phase of composting. Dubey and Maheshwan (2005) have stated that the cellulytic fungi such as *Aspergillus*, *Penicillium*, *Trichoderman*and *Trichurus*accelerate composting for efficient recycling of dry waste with high C/N ratio and reduce composting period.

The isolated Aspergillus species from compost were *Aspergilus fumigates*, *Aspergillus niger* and *Aspergillus candidus.* These association of *Aspergillus species* have been reported by Anastasi *et al*., (2005); Dubey and Maheskwan (2005); Rabia, *et al.,* (2005). The isolates correspond with that of Rabia *et al*. (2007), who have reported the highest load and number of species of *Aspergillus* in addition to *Penicillium* in compost studied. The finding of Storm (1985) was in agreement with the results that the number and diversity of microorganism is more when two or more wastes are used for composting. The finding of Storm (1985) was in agreement with the experimental results, that the number and diversity of microorganism is more when two or more wastes are used for composting.

Penicillium was the most common fungal genus isolated from the anaerobic compost. The isolated species were *P. aethiopicum, P. oxalicum, P. funculosum, P. polonicum* and *P. variable*. The abundance can be attributed to its universal presence as a saprophyte growing on dead leaves, woods and other decaying vegetation. The spores are widespread and are often associated with organic materials and soil.

Fusariumm species were also isolated from the compost samples. Giovano *et al.* (2005) reported that *Fusarium*is another isolation of a low number of a potential phytopathogenetic species from compost. *Fusarium sp.* are also widely distributed in all soils and are responsible for the decomposition of compost by their growth hyphea and are regarded as imperfect fungi and Lesite and Summerell (2006) also identified *Fusarium sp.* morphologically and concluded that the arrangement of *Macroconidia* on the Conidiogenous cells either in singly, false head or chain.

4.0 Summary and Conclusion

The values of the nutrient content present in the composted waste were: organic matter (48.76 g/kg), nitrogen (45.00 g/kg), phosphorus (6.14 mg/g), potassium (9.19 cmol (+)/kg), Ca (19.63 Cmol(+)/kg). These high nutrient values make the compost suitable for the improvement of soil quality and crop production. This method can be practice by local farmers to ameliorate soil for sustainable crop production. Also because of the alkaline nature of the compost, it can used as liming material to reduce soil acidity. In conclusion it is a preferable fertilizer source to amend degraded soil with low organic matter compared to mineral fertilizer. The main fungi genera isolated from the anaerobic compost were *Aspergillus, Penicillium, Fusarium* and *Eurotium.*

Table 1: Nutrient content of anaerobic Compost and soil

Parameters	Units	Values	
		Compost	Soil
pH	-	7.66	5.95
OM	g/kg	48.76	15.50
Total N	g/kg	45.00	0.90
Available P	mg/g	6.14	9.18
Exchangeable Ca	cmol(+)/kg	19.63	3.54
Mg	cmol(+)/kg	2.18	1.04
K	cmo(+)l/kg	9.19	0.08
Na	cmol(+)/kg	0.11	0.37
Extractable Mn	mg/kg	180.39	Particle size (g/kg)
Extractable Fe	mg/kg	4,950.09	Sand-832
Extractable Cu	mg/kg	7.35	Silt-114
Extractable Zn	mg/kg	82.84	Clay-54
			Textural class -Loamy sand

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